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1 6. A method as recited in claim 1 and further comprising conditioning
2 the edit operation on a position that the edit occurs at within the word.

3
4 7. A method as recited in claim 1 and further comprising identifying the
5 string as potentially incorrect.

6
7 8. A method as recited in claim 1 and further comprising correcting the
8 string to the word.

9
10 9. A computer readable medium having computer-executable
11 instructions that, when executed on a processor, perform the method as recited in
12 claim 1.

13
14 10. A method comprising:
15 receiving an entered string s ; and
16 determining a probability $P(s|w)$ expressing how likely a word w was to
17 have been incorrectly entered as the string s based on one or more edit operations
18 that convert first arbitrary-length character sequences $\alpha_1, \alpha_2, \alpha_3, \dots, \alpha_n$ in the
19 word w to corresponding second arbitrary-length character sequences $\beta_1, \beta_2, \beta_3,$
20 \dots, β_n in the string s , wherein:

$$21 \\ 22 \quad P(s|w) = P(\beta_1|\alpha_1) * P(\beta_2|\alpha_2) * P(\beta_3|\alpha_3) * \dots * P(\beta_n|\alpha_n) \\ 23 \\ 24 \\ 25$$

1 11. A method as recited in claim 10, wherein lengths of corresponding
2 first and second character sequences are different.

3
4 12. A method as recited in claim 10 and further comprising determining
5 how likely the word w is to have been generated.

6
7 13. A method as recited in claim 10 and further comprising conditioning
8 the edit operations on positions that the edits occur at within the word.

9
10 14. A method as recited in claim 10 and further comprising correcting
11 the string s to the word w .

12
13 15. A method as recited in claim 10 and further comprising identifying
14 the string s as potentially incorrect.

15
16 16. A computer readable medium having computer-executable
17 instructions that, when executed on a processor, perform the method as recited in
18 claim 10.

19
20 17. A method comprising:
21 receiving an entered string s ; and
22 determining a probability $P(s|w)$ expressing how likely a word w was to
23 have been incorrectly entered as the string s , by partitioning the word w and the
24 string s and computing probabilities for various partitionings, as follows:
25

$$P(s | w) = \sum_{R \in \text{Part}(w)} P(R | w) \sum_{\substack{T \in \text{Part}(s) \\ |T|=|R|}} \prod_{i=1}^{|R|} P(T_i | R_i)$$

where $\text{Part}(w)$ is a set of possible ways of partitioning the word w , $\text{Part}(s)$ is a set of possible ways of partitioning the string s , R is a particular partition of the word w , and T is a particular partition of the string s .

18. A method as recited in claim 17 and further comprising selecting the partition that returns a highest probability.

19. A method as recited in claim 17 and further comprising determining how likely the word w is to have been generated.

20. A method as recited in claim 17 and further comprising correcting the string s to the word w .

21. A method as recited in claim 17 and further comprising identifying the string s as potentially incorrect.

22. A computer readable medium having computer-executable instructions that, when executed on a processor, perform the method as recited in claim 17.

23. A method comprising:

receiving an entered string s ; and

determining a probability $P(s|w)$ expressing how likely a word w was to have been incorrectly entered as the string s , by partitioning the word w and the string s and computing probabilities for various partitionings, as follows:

$$P(s|w) = \max_{R \in \text{Part}(w), T \in \text{Part}(s)} P(R|w) * \prod_{i=1}^{|R|} P(T_i|R_i)$$

where $\text{Part}(w)$ is a set of possible ways of partitioning the word w , $\text{Part}(s)$ is a set of possible ways of partitioning the string s , R is a particular partition of the word w , and T is a particular partition of the string s .

24. A method as recited in claim 23 and further comprising omitting the term $P(R|w)$ from the computation of $P(s|w)$.

25. A method as recited in claim 23 and further comprising setting terms $P(T_i|R_i) = 1$ whenever $T_i = R_i$.

26. A method as recited in claim 23 and further comprising determining how likely the word w is to have been generated.

27. A method as recited in claim 23 and further comprising correcting the string s to the word w .

1 28. A method as recited in claim 23 and further comprising identifying
2 the string s as potentially incorrect.

3
4 29. A computer readable medium having computer-executable
5 instructions that, when executed on a processor, perform the method as recited in
6 claim 23.

7
8 30. A method comprising:
9 receiving an entered string s ; and
10 determining a probability $P(s|w)$ expressing how likely a word w was to
11 have been incorrectly entered as the string s , by partitioning the word w and the
12 string s and finding a partition R of the word w and a partition T of the string s
13 such that $\prod_{i=1}^{|R|} P(T_i | R_i)$ is maximized.

14
15 31. A method as recited in claim 30 and further comprising determining
16 how likely the word w is to have been generated.

17
18 32. A method as recited in claim 30 and further comprising correcting
19 the string s to the word w .

20
21 33. A method as recited in claim 30 and further comprising identifying
22 the string s as potentially incorrect.
23
24
25

1 34. A computer readable medium having computer-executable
2 instructions that, when executed on a processor, perform the method as recited in
3 claim 30.

4
5 35. A method for training an error model used in a spell checker,
6 comprising:

7 determining, given a <wrong, right> training pair and multiple single
8 character edits that convert characters in one of the right or wrong strings to
9 characters in the other of the right or wrong strings at differing costs, an alignment
10 of the wrong string and the right string that results is a least cost to convert the
11 characters;

12 collapsing any contiguous non-match edits into one or more common error
13 regions, each error region containing one or more characters that can be converted
14 to one or more other characters using a substitution edit; and

15 computing a probability for each substitution edit.

16
17 36. A method as recited in claim 35, wherein the assigning comprises
18 assessing a cost of 0 to all match edits and a cost of 1 to all non-match edits.

19
20 37. A method as recited in claim 35, wherein the single character edits
21 comprises insertion, deletion, and substitution.

22
23 38. A method as recited in claim 35, further comprising collecting
24 multiple <wrong, right> training pairs from online resources.
25

1 39. A method as recited in claim 35, further comprising expanding each
2 of the error regions to capture at least one character on at least one side of the error
3 region.

4
5 40. A program embodied on a computer readable medium, which when
6 executed, directs a computer to perform the following:

7 receive an entered string; and

8 determine how likely an expected string was to have been entered as the
9 entered string based on at least one edit operation that converts a first character
10 sequence of arbitrary length in the expected string to a second character sequence
11 of arbitrary length in the entered string

12
13 41. A program as recited in claim 40, wherein the first character
14 sequence has a first length and the second character sequence has a second length
15 that is different than the first length.

16
17 42. A program as recited in claim 40, wherein the first character
18 sequence has multiple characters and the second character sequence has multiple
19 characters.

20
21 43. A program as recited in claim 40, wherein the first character
22 sequence has a first number of multiple characters and the second character
23 sequence has a second number of multiple characters that is different from the first
24 number of multiple characters.
25

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1 44. A program as recited in claim 40, further comprising computer-
2 executable instructions that directs a computer to determine how likely the
3 expected string is to have been generated.

4
5 45. A program as recited in claim 40, further comprising computer-
6 executable instructions that directs a computer to perform, depending upon how
7 likely an expected string was to be incorrectly entered as the entered string, one of
8 the following: (1) leave the entered string unchanged, (2) autocorrect the entered
9 string into the expected string, or (3) offer a list of possible corrections.

10
11 46. A spell checker program, embodied on a computer-readable
12 medium, comprising the program of claim 40.

13
14 47. A language conversion program, embodied on a computer-readable
15 medium, comprising the program of claim 40.

16
17 48. A word processing program, embodied on a computer-readable
18 medium, comprising the program of claim 40.

19
20 49. A program embodied on a computer readable medium, which when
21 executed, directs a computer to perform the following:

22 (1) receive an entered string s ;

23 (2) for multiple words w in a dictionary, determine:

24 (a) how likely a word w in a dictionary is to have been generated,

25 $P(w|context)$; and

1 (b) how likely the word w was to have been entered as the string
2 s , $P(s|w)$, based on at least one edit operation that converts a first
3 character sequence of arbitrary length in the word to a second
4 character sequence of arbitrary length in the string; and
5 (3) maximize $P(s|w) * P(w|context)$ to identify which of the words is most
6 likely the word intended when the string s was entered.

7
8 50. A program as recited in claim 49, wherein the determination (2) is
9 performed for all words in the dictionary.

10
11 51. A program as recited in claim 49, further comprising computer-
12 executable instructions that directs a computer to either (1) leave the string
13 unchanged, (2) autocorrect the string into the word, or (3) offer a list of possible
14 corrections.

15
16 52. A spell checker program, embodied on a computer-readable
17 medium, comprising the program of claim 49.

18
19 53. A language conversion program, embodied on a computer-readable
20 medium, comprising the program of claim 49.

21
22 54. A spell checker comprising:
23 a source model component to determine how likely a word w in a
24 dictionary is to have been generated; and
25

an error model component to determine how likely the word w was to have been incorrectly entered as the string s based on arbitrary length string-to-string transformations.

55. A spell checker as recited in claim 54, wherein the string-to-string transformations involve conversion of a first character sequence of a first length into a second character sequence of a second length that is different than the first length.

56. A spell checker as recited in claim 54, wherein the string-to-string transformations involve conversion of a first character sequence with multiple characters into a second character sequence with multiple characters.

57. A spell checker as recited in claim 54, wherein the string-to-string transformations involve conversion of a first character sequence having a first number of multiple characters into a second character sequence having a second number of multiple characters that is different from the first number of multiple characters.

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